National Aeronautics and
Space Administration

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**George C. Marshall Space Flight Center**
Marshall Space Flight Center, Alabama 35812

EI11

MULTIPROGRAM/PROJECT COMMON-USE DOCUMENT

# THREADED FASTENERS, REQUIREMENTS FOR SECURING OF FLIGHT HARDWARE USED ON SHUTTLE PAYLOADS AND EXPERIMENTS

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## DOCUMENT HISTORY LOG

| Status (Baseline/ Revision/ Canceled) | Document Revision | Effective Date | Description |
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| Baseline | -- | -- | Baseline Release |
| Revision | A | 2/01/1995 | Revision "A" replaces baseline release in its entirety. |
| Revision | B | 11/18/2004 | Revision "B" completed due to Center Rules Review. |
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FOREWORD

CONTENTS



1. SCOPE

1.1 This standard applies to Shuttle payloads (experiments, Mission Peculiar Equipment, etc.) for which MSFC has integration and or development responsibility. All structural and mechanical system hardware fasteners (NHB 1700.7) event.

1.2 Vibration testing has shown that thread fasteners may work loose and cause a hazard during actual flight conditions. This standard provides requirements and guidance for designers concerned with this potential problem.

2. APPLICABLE DOCUMENTS

| | | |
|---|---|---|
| a. | NASM33540 | Safety Wiring and Cotter Pinning, General Practices for |
| b. | MSFC-STD-486 | Threaded Fasteners, Torque Limits for |
| c. | NASM1312-7 | Fastener Test Methods, Vibration |
| d. | NASA-STD-5003 | Fracture Control Requirements for Payloads Using Space Transportation System |
| e. | NSTS 1700.7 | Safety Policy and Requirements for Payloads Using the Space Transportation System |
| f. | NSTS 08307 | Criteria for Preloaded bolts |
| g. | AS4536 | Safety Cable Kit Procurement Specification and Requirements for use |
| h. | MWI 7120.4 | Documentation Preparation, Programs/Projects |
| i. | MPR 7120.2 | Multiprogram/Project Common-Use Documentation |
| j. | MSFC-SPEC-250 | Protective Finishes for Space Vehicle Structures and Associated Flight Equipment |
| k. | MSFC-STD-506 | Materials and Processes Control Standard |
| l. | MSFC-STD-2594 | MSFC Fastener Management and Control Practices |

## 3. DEFINITIONS

Threaded fasteners are defined as screws, bolts, and nuts that are designed to be removed and reinstalled without functional damage to the fasteners. The cognizant engineering organization is defined as the activity which designs and produces end items for delivery to the government. The prime contractor shall be the cognizant engineering organization for sub-contractors and vendors. The prime contractor may delegate this responsibility to the sub-contractors or vendors.

## 4. GENERAL REQUIREMENTS

The cognizant engineering organization shall be responsible for application of good engineering practices to insure the safety of any fastener not specifically covered by the following requirements. The government reserves the right to inspect, test, and modify any fastener system when the potential for a catastrophic failure exists.

## 5. DETAILED REQUIREMENTS

5.1 All hardware designs shall utilize MSFC-STD-486 to establish the torque requirements, and these values shall be shown on the drawings. Design drawings shall specify which fasteners are to be safety wired, safety cabled, or cotter pinned. Safety wire, safety cable, cotter pins, and locking compounds shall be specified by part number on the drawing. Materials used for safety wire, safety cable, cotter pins shall comply with Table III of MSFC-SPEC-250. Safety wire and cotter pins shall be installed in accordance with MS33540; safety cable shall be installed in accordance with SAE Aerospace Standard AS 4536.

5.1.1 Fracture critical threaded fasteners (per NHB 8071.1) shall be safety wired, safety cabled, or cotter pin to provide mechanical safing. Random vibration testing of the as used configuration shall not be used to justify a waiver to this requirement.

5.1.2 Threaded fasteners used in application of retaining a rotating device (wheel and axle concept) shall be safety wired, safety cabled, or cotter pinned. Random vibration testing of the used configuration shall not be used to justify a waiver to this requirement.

5.1.3 Redundant threaded fasteners (non fracture critical) shall employ safety wire, cotter pins, or self-locking threaded devices, or approved locking compounds. A Materials Usage Agreement (MUA) in accordance with (IAW) MSFC-STD-506 shall be submitted for all proposed locking compounds. Self-locking threaded devices shall meet MIL-STD-1312-7 or equivalent, as defined in the threaded fastener's standards procurement specification.

5.1.4 Hardware which is designed for permanent installation shall use non-removable type fasteners, where possible. Designs for non-permanent installations (e.g., experiments or

structural members that are changed for different flights) requiring the use of threaded fasteners shall avoid configurations that include inaccessible or difficult locations.

5.1.5 Exposed sharp ends of locking devices that could damage astronaut equipment or rupture lines during EVA shall be sealed with an approved compound. A MUA IAW MSFC-STD-506 shall be submitted for all proposed sealants.

5.1.6 Special precaution shall be exercised to preclude the possibility of mechanical equipment becoming jammed. When installing safety wire, safety cable, or cotter pins, cutoff remains shall be collected and properly discarded.

5.1.7 All hardware designs shall utilize the analysis methodology provided in NSTS08307. The procedure outlined in this document ensures that preloaded bolts have adequate strength and life, and that the joint itself will not experience separation.

5.1.8 Structural, fracture critical, and safety critical fasteners as defined by the program/project that are procured, received, tested, inventoried or installed for space flight by the Center or its contractors must meet the requirements of MSFC-STD-2594.

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